



## **Does ethnicity and education influence preoperative disability and expectations in patients undergoing total knee arthroplasty?**

Kudibal, Madeline Therese; Kallemose, Thomas; Troelsen, Anders; Husted, Henrik; Gromov, Kirill

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Observational Study

# Does ethnicity and education influence preoperative disability and expectations in patients undergoing total knee arthroplasty?

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## Abstract

### AIM

To investigate whether minority ethnicity and the duration of education influence preoperative disability and expectations in patients undergoing total knee arthroplasty.

### METHODS

We prospectively included 829 patients undergoing primary unilateral total knee arthroplasty (TKA) from April 2013 to December 2014 at a single centre. Patients filled in pre-operative questionnaires with information regarding place of birth, duration of education, expectations for outcome of surgery and baseline characteristics. Patients were stratified based on ethnicity. Majority ethnicity was defined as born in



the study country and minority ethnicity was defined as born in any other country. Similarly, patients were stratified based on duration of education in groups defined as < 9 years, 9-12 years and > 12 years, respectively.

## RESULTS

We found that 92.2% of patients were of majority ethnicity. We found that 24.5%, 44.8% and 30.8% of patients had an education of < 9 years, 9-12 years and > 12 years, respectively. The mean preoperative (pre-OP) oxford knee score (OKS) in the total population was 23.6. Patients of minority ethnicity had lower mean pre-OP OKS (18.6 *vs* 23.9,  $P < 0.001$ ), higher pain levels (VAS 73.0 *vs* 58.7,  $P < 0.001$ ), expected higher levels of post-OP pain (VAS 14.1 *vs* 6.1,  $P = 0.02$ ) and of overall symptoms (VAS 16.6 *vs* 6.4,  $P = 0.006$ ). Patients with > 12 years education had lower mean pre-OP OKS (21.5 *vs* 23.8 and 24.6,  $P < 0.001$ ) and higher pre-OP VAS pain (65.4 *vs* 59.2 and 56.4,  $P < 0.001$ ) compared to groups with shorter education. One year post-operative (post-OP) patients of minority ethnicity had lower mean OKS, higher pain and lower QoL. One year post-OP patients with > 12 years education reported higher pain compared to patients with shorter educations. However, the response-rate was low (44.6%), and therefore post-OP results were not considered to be significant.

## CONCLUSION

Minority ethnicity and the duration of education influence preoperative disability and expectation in patients undergoing TKA. This should be taken into account when patients are advised pre-operatively.

**Key words:** Socioeconomic factors; Ethnicity; Education; Expectations to surgery; Preoperative disability; Total knee arthroplasty

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**Core tip:** We investigated whether minority ethnicity and duration of education influence preoperative disability and expectations in patients undergoing total knee arthroplasty. We prospectively included 829 patients scheduled to undergo primary total knee arthroplasty in a single centre. We found that patients of minority ethnicity suffer from more severe preoperative symptoms and expect a poorer post-operative outcome compared to patients of majority ethnicity. We also found that patients with > 12 years education have more severe preoperative symptoms compared to patients with shorter educations. This information can assist surgeons in appropriate treatment plans and preoperative consultation for all patients.

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## INTRODUCTION

Thousands of patients undergo total knee arthroplasty (TKA) every year worldwide. In recent years, pre-operative (pre-OP) planning and patient information has been streamlined by using the fast-track concept<sup>[1]</sup>. This operation has excellent results in terms of survival, with a reported ten-year prosthetic survival of close to 95% (National Hospital Discharge Survey 2010); however, patient satisfaction remains a challenge, with up to 20% of patients being dissatisfied with their one-year post-operative (post-OP) outcomes<sup>[2,3]</sup>.

Outcome is known to be influenced by patient-related factors that include age, pre-OP symptoms<sup>[4-6]</sup>, comorbidities and mental health status, such as depression and anxiety<sup>[7]</sup>. Previous studies have shown that patient satisfaction can be influenced by both surgery-related factors, such as implant alignment<sup>[8-10]</sup>, implant brand and hospital type<sup>[8]</sup>, as well as patient-related factors including age, pre-OP symptoms and expectations<sup>[2]</sup>. Other less well-defined factors have also been shown to influence outcome following TKA and THA, such as socioeconomic factors<sup>[11,12]</sup> and duration of education<sup>[13]</sup>. Understanding the way that ethnicity and the duration of education influence both pre-OP symptoms and post-OP outcome in TKA patients will assist healthcare providers in determining specific areas of possible improvement and adjusting treatment options appropriately. Furthermore, it will assist in more accurate comparisons of study populations in future research.

The purpose of the study was to investigate whether minority ethnicity and duration of education influence pre-OP disability and expectations in patients undergoing TKA.

## MATERIALS AND METHODS

We conducted a prospective cohort study that included all patients undergoing primary TKA at our institution from April 1<sup>st</sup> 2013 to December 8<sup>th</sup> 2014. Exclusion criteria were simultaneous bilateral TKA and missing data on education/country of origin. Prior to surgery, patients were asked to fill in a questionnaire regarding patient demographics, pre-OP symptoms and expectations about surgery outcome. All patients were asked to fill in another questionnaire one year post-OP *via* email or regular mail, and 370 patients completed a one-year follow-up questionnaire (Figure 1). A clinical control was not conducted. Patients filled in the questionnaire independently or with help from

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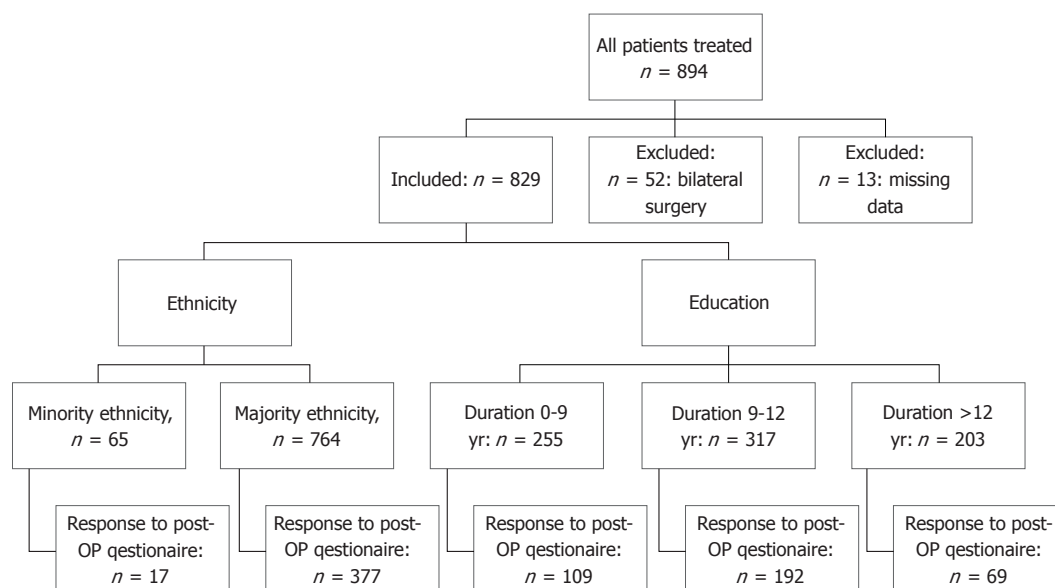


Figure 1 Flowchart of patient distribution.

family members. All surgeries were performed in a standardized fast-track setup<sup>[1]</sup> by experienced surgeons specializing in arthroplasty surgery, each having performed > 100 primary TKAs annually. The standard surgical protocol for TKA includes spinal analgesia, standardized fluid management, use of preoperative intravenous tranexamic acid, preoperative single-shot high-dose methylprednisolone<sup>[14]</sup> and absence of drains. All TKAs were performed with a standard medial parapatellar approach without the use of tourniquet, with an application of local infiltration analgesia (LIA)<sup>[15]</sup> and postoperative compression bandaging<sup>[16]</sup>. Post-operative opioid-sparing pain treatment consisted of celecoxib 200 mg/12 h and paracetamol 1 g/6 h with rescue analgesics [administered if visual analogue scale (VAS) > 50 mm at rest] consisting of 10 mg oral morphine as needed. Physiotherapy was started on the day of surgery and continued until discharge. Rivaroxaban (Bayer, Denmark) was used as oral thromboprophylaxis starting 6 to 8 h postoperatively and continued daily until discharge<sup>[17]</sup>. Mechanical thromboprophylaxis and extended oral thromboprophylaxis were not used. Patients were discharged to their own home upon fulfilling functional discharge criteria<sup>[18]</sup>.

Preoperative disability was measured by Oxford knee score (OKS), self-reported quality of life (QoL)<sup>[19]</sup>, knee pain during activity measured on VAS, and overall symptoms and expectations. OKS ranges from 0 to 48, with lower numbers indicating more severe symptomatic disease. All VAS scales in this study range from 0 to 100. For pain and symptoms, higher values represent the worst conditions, while high values on the scale for QoL represent the best conditions. Patients were stratified based on duration of education and place of birth. Ethnicity was divided into two groups, majority and minority ethnicity. Majority ethnicity was defined

as patients born in Denmark (the study country), and minority ethnicity was defined as all patients born outside Denmark. As the level of education varies between countries, education was stratified based on duration (< 9 years, 9-12 years and > 12 years of education). Preoperatively, we registered baseline-characteristics including alcohol consumption, smoking, BMI and comorbidity. Comorbidity was registered as heart disease, lung disease, previous stroke, kidney disease, liver disease, diabetes and autoimmune disease. We also registered symptoms (OKS, use of walking aids, walking distance, pain on VAS score during rest and activity) self-reported QoL, and expectations for post-OP symptoms and QoL. Finally, we registered self-reported post-OP symptoms and self-reported QoL using the one-year post-op questionnaire.

As all our results are based on patient reported outcome measures, we take into account the minimal clinically important difference (MCID). For OKS, this is acknowledged to be four-five<sup>[20,21]</sup>. For VAS scales in knee arthritis patients, MCID has been reported to be around 20 points<sup>[22]</sup>.

### Statistical analysis

All data were processed in R 3.2.2. All measurements were reported as mean with standard deviation (SD) for continues variables and number with percent for categorical variables. Tests for association of minority ethnicity with continues interest variables was done by *t*-test or for non-normal distributed variables by Wilcoxon sum rank test. Association with categorical interest variables was done by chi-squared or, in cases with expected values below 5, Fishers exact test. Associations between education duration groups and the interest variables were done for continues variables by uni-

**Table 1** Characteristics of the total patient population *n* (%)

	All patients
Baseline characteristics	
BMI (mean $\pm$ SD)	29.7 $\pm$ 5
Age (mean $\pm$ SD)	66.8 $\pm$ 10
Gender	
Male	308 (36.6)
Female	534 (63.4)
Smoking	
Non-smoker	492 (58.6)
Former smoker	213 (25.4)
Active smoker	134 (16)
Duration of education	
More than 12 yr	255 (30.8)
9-12 yr	371 (44.8)
0-9 yr	203 (24.5)
Ethnicity	
Born in Denmark	764 (92.2)
Born outside Denmark	65 (7.8)
Preoperative level of function and symptoms	
Walking aid outside the home:	
None	597 (71.2)
One cane	133 (15.9)
Two canes	34 (4.1)
Wheeled walker	69 (8.2)
Do not leave the home	6 (0.7)
Oxford knee score (mean $\pm$ SD)	23.6 $\pm$ 8
Knee pain during activity <sup>1</sup> , median (range)	63 (0:100)
Quality of life <sup>1</sup> , median (range)	47 (0:100)
Level of symptoms <sup>1</sup> , median (range)	50 (0:100)
Preoperative expectations	
Knee pain 1 yr after surgery <sup>1</sup> , median (range)	2 (0:100)
Quality of life 1 yr post-OP <sup>1</sup> , median (range)	94 (0:100)
Level of symptoms. 1 yr post-OP <sup>1</sup> , median (range)	3 (0:99)

<sup>1</sup>Visual analogue scale 0-100. BMI: Body mass index.

variable linear regression with TYPE III test or Kruskal-Wallis sum rank test for non-normal distributed variables, and for categorical variables chi-square and Fishers exact test. Additionally, to adjust for multiple testing, a Bonferroni correction was done for all *P*-values, and the correction scale was given by the number of tests performed within each outcome group. The adjusted *P*-value was calculated by multiplying the original *P*-values by the given scale. *P* < 0.05 was considered significant.

## RESULTS

We included 894 consecutive and unselected patients undergoing TKA at our institution. The following were excluded: simultaneous bilateral TKA (*n* = 52) and missing data on education/country of origin (*n* = 13), thus leaving 829 patients for analysis.

For the total population, mean  $\pm$  SD at time of surgery was 66.8 (10) years, 63.4% were female and 764 (92.2%) of patients were of majority ethnicity. Specifically, 24.5% of patients had an education of < 9 years, 44.8% of 9-12 years and 30.8% > 12 years (Table 1). Mean pre-OP OKS (SD) was 23.6 (8). Patients of minority ethnicity were younger compared to patients of majority ethnicity (*P* = 0.045) and had

a shorter education (72.3% had an education of 0-9 years while only 20.4% of patients with majority ethnicity had an education of this length (*P* < 0.001) (Table 2). Patients of minority ethnicity had a lower pre-OP OKS (*P* < 0.005), higher knee pain during activity (*P* < 0.001), and a significantly larger proportion were dependent on a walking aid (*P* = 0.026) (Table 2). Furthermore, this patient group had a significantly lower expectation to their post-OP pain during activity (*P* = 0.016) and overall symptoms (*P* = 0.016). Patients with an education of > 12 years were older at the time of surgery, with a mean age of 67.7 years compared to 64.8 years for patients with an education of 0-9 years (*P* < 0.001). Patients with an education > 12 years reported a lower pre-OP OKS compared to the groups with 9-12 years and < 9 years of education (*P* < 0.001). Concurrent to this, patients with an education > 12 years had a higher pre-OP VAS for knee pain during activity compared to the other groups (*P* = 0.002, expectation measures also differed between the education groups (all *P*  $\leq$  0.008)). Women composed a higher proportion of the highly educated group, with 73.4% compared to 57.1% and 63.0% in the middle and low education groups, respectively (*P* = 0.003) (Table 3).

Response-rates to the post-OP questionnaire were 44.6% (*n* = 370). We found a higher response-rate for patients of majority ethnicity (46.2% vs 26.2% for minority ethnicity patients). We also found that responders overall had a longer duration of education, the biggest difference seen in education of 0-9 years (29.2% for non-responders vs 18.6% for responders, *P* < 0.001). The differences between responders and non-responders for other parameters was not statistically significant.

Patients of minority ethnicity had significantly lower mean OKS one year post-OP compared with patients of majority ethnicity (*P* = 0.002). Patients of minority ethnicity also reported higher pain during activity (*P* = 0.001), a significantly lower QoL (*P* = 0.001) and significantly higher overall symptom score (*P* = 0.001) compared with patients of majority ethnicity. Although patients of minority ethnicity had higher post-OP pain, we also found a larger difference between pre-OP and post-OP pain compared to patients of majority ethnicity (*P* = 0.049) (Table 2). Patients with educations > 12 years had significantly higher knee pain post-OP (*P* = 0.006), however there was also a larger difference between pre-OP and post-OP pain during activity (*P* = 0.069) and QoL (*P* = 0.017) (Table 3).

## DISCUSSION

In this prospective study, we found that patients of minority ethnicity report more severe pre-OP symptoms (lower OKS and higher overall pain level) and have lower expectations for post-OP outcome compared to patients of majority ethnicity. Patients of minority



**Table 2** Significance of ethnicity *n* (%)

	Majority ethnicity	Minority ethnicity	<i>P</i> value (adjusted)
Baseline characteristics			
BMI (mean $\pm$ SD)	29.7 $\pm$ 5	29.9 $\pm$ 4	0.702 (3.508)
Age (mean $\pm$ SD)	67.0 $\pm$ 10	64.0 $\pm$ 9	0.009 (0.045)
Gender			
Male	294 (37.36)	11 (15.22)	< 0.001 (0.004)
Female	470 (62.64)	54 (84.78)	
Smoking			
Non-smoker	430 (56.3)	55 (84.6)	< 0.001 (< 0.001)
Former smoker	207 (27.1)	4 (6.5)	
Active smoker	127 (16.6)	6 (9.2)	
Duration of education			
More than 12 yr	248 (32.5)	7 (10.8)	< 0.001 (< 0.001)
9-12 yr	369 (47.1)	11 (16.9)	
0-9 yr	156 (20.4)	47 (72.3)	
Preoperative level of function and symptoms			
Walking aid outside the home:			
None	556 (72.8)	34 (52.3)	0.005 (0.026)
One cane	111 (14.9)	20 (30.8)	
Two canes	30 (3.9)	3 (4.6)	
Wheeled walker	61 (8)	8 (12.3)	
Do not leave the home	6 (0.8)	0 (0)	
Oxford knee score (mean $\pm$ SD)	23.9 $\pm$ 7	18.6 $\pm$ 8	< 0.001 (< 0.001)
Knee pain during activity <sup>1</sup> , median (range)	61.0 (0:100)	76 (13:100)	< 0.001 (< 0.001)
Quality of life before surgery <sup>1</sup> , median (range)	47.0 (0:100)	38 (0:100)	0.388 (1.938)
Level of symptoms before surgery <sup>1</sup> , median (range)	50.0 (0:100)	61 (0:100)	0.276 (1.380)
Preoperative expectations			
Expectations to knee pain caused by use of hip 1 yr after surgery <sup>1</sup> , median (range)	2.0 (0:100)	4 (0:99)	0.005 (0.016)
Expectations to quality of life 1 yr after surgery <sup>1</sup> , median (range)	94.0 (0:100)	92 (0:100)	0.296 (0.888)
Expectations to level of symptoms 1 yr after surgery <sup>1</sup> , median (range)	3.0 (0:99)	6 (0:99)	0.005 (0.016)
Postoperative level of function and symptoms:			
Oxford knee score, median (range)	39.0 (3.0:48.0)	24.0 (10.0:47.0)	< 0.001 (0.002)
Knee pain during act <sup>1</sup> , median (range)	18.0 (0.0:100.0)	62.0 (5.0:90.0)	< 0.001 (< 0.001)
Quality of life <sup>1</sup> , median (range)	71.5 (0.0:100.0)	40.0 (0.0:95.0)	< 0.001 (0.001)
Level of symptoms <sup>1</sup> , median (range)	21.0 (0.0:100.0)	62.0 (10.0:90.0)	< 0.001 (0.001)
Difference in outcome parameters:			
Difference in Pain <sup>1</sup> , median (range)	13.0 (90.0:100.0)	47.0 (37.0:90.0)	0.008 (0.0499)
Difference in Quality of life after surgery <sup>1</sup> , median (range)	15.0 (100.0:98.0)	44.0 (99.0:38.0)	0.013 (0.078)
Difference in level of symptoms <sup>1</sup> , median (range)	17 (56.0:100.0)	46.0 (36.0:88.0)	0.299 (1.796)

<sup>1</sup>Visual analogue scale 0-100. BMI: Body mass index.

ethnicity also report more severe symptoms post-OP, however our response rate was too low to regard the results as significant. Patients with an education > 12 years report more severe pre-OP symptoms (OKS and overall pain level) compared to patients with both < 9 years and 9-12 years of education. Post-OP, we found that patients with an education > 12 years reported higher overall pain.

It is generally acknowledged that patient's overall health is associated with socioeconomic factors<sup>[23]</sup>. Recently, Lavernia *et al*<sup>[11]</sup> showed that expectations and the knowledge of prosthetic surgery in patients with knee and hip arthritis depend on ethnicity. The same observation was made by Krupic *et al*<sup>[12]</sup>, who showed that patients born outside of Sweden had a poorer outcome after total hip replacement than patients born within Sweden. This is concurrent with our results, as we find that patients born outside the country have greater preoperative disability (lower OKS and higher VAS for pain). However, the studies describing the

correlations between ethnicity and surgery are few and based on short-term observation.

In general, minority groups in western countries are less likely to undergo knee replacement than their locally-born counterparts<sup>[24-26]</sup>. Our data show that patients of minority ethnicity have lower expectations for surgery and suffer from more severe symptoms pre-OP than patients of majority ethnicity. The reason for this difference is unknown, but we could speculate that patients of minority ethnicity might seek doctors at a more progressed stage of the disease compared to patients of majority ethnicity due to cultural or language barriers. Shahid *et al*<sup>[25]</sup> reports that racial disparities in African Americans compared to Caucasian Americans are caused by patient preferences, patients education/knowledge of osteoarthritis (OA) and expectations for post-OP outcome. Minority Americans were found to have lower expectations of the overall effect of OA surgery and higher expectations of post-OP pain<sup>[24,27-29]</sup>. This supports our findings that patients of minority ethnicity

**Table 3** Significance of duration of education *n* (%)

	Education 0-9 yr	Education 9-12 yr	Education > 12 yr	<i>P</i> value (adjusted)
Baseline characteristics				
BMI, mean $\pm$ SD	28.7 $\pm$ 5	30.0 $\pm$ 6	30.5 $\pm$ 5	< 0.001 (0.007)
Age, mean $\pm$ SD	64.8 $\pm$ 10	67.8 $\pm$ 10	67.7 $\pm$ 11	< 0.001 (0.005)
Gender				
Male	92 (36.1)	159 (42.9)	54 (26.6)	< 0.001 (0.003)
Female	163 (63.9)	212 (57.1)	149 (73.4)	
Ethnicity				
Majority ethnicity	248 (97.3)	360 (97)	156 (76.8)	< 0.001 (< 0.001)
Minority ethnicity	7 (2.7)	11 (3)	47 (23.2)	
Smoking:				
Non-smoker	155 (60.8)	207 (55.8)	123 (60.6)	0.003 (0.017)
Former smoker	74 (29)	100 (27)	37 (18.2)	
Active smoker	26 (10.2)	64 (17.3)	43 (21.2)	
Preoperative level of function and symptoms				
Walking aid outside the home	198 (77.6)	273 (73.6)	119 (58.6)	0.005 (0.002)
None	35 (13.7)	55 (14.8)	41 (20.2)	
One cane	11 (4.3)	12 (3.2)	10 (4.9)	
Two canes	10 (3.9)	27 (7.3)	32 (15.8)	
Wheeled walker housebound	1 (0.4)	4 (1.1)	1 (0.5)	< 0.001 (< 0.001)
Oxford knee score, mean $\pm$ SD	24.6 $\pm$ 8	23.8 $\pm$ 7	21.5 $\pm$ 8	
Knee pain during activity <sup>1</sup> , median (range)	59 (0:99)	63 (0:100)	67 (6:100)	
Quality of life before surgery <sup>1</sup> , median (range)	45 (0:100)	47 (0:100)	50 (0:100)	0.634 (3.170)
Level of symptoms before surgery <sup>1</sup> , median (range)	51 (0:100)	50 (0:100)	50 (0:100)	0.634 (3.171)
Preoperative expectations				
Expectations to knee pain caused by use of hip 1 yr after surgery <sup>1</sup> , median (range)	4 (0:95)	2 (0:96)	2 (0:100)	0.003 (0.008)
Expectations to quality of life 1 yr after surgery <sup>1</sup> , median (range)	90 (0:100)	94 (0:100)	96 (0:100)	< 0.001 (0.002)
Expectations to level of symptoms 1 yr after surgery <sup>1</sup> , median (range)	4 (0:82)	2 (0:99)	2 (0:99)	< 0.001 (0.001)
Postoperative level of function and symptoms:				
Oxford knee score, median (range)	40 (8.0:47.0)	37 (3.0:48.0)	37.5 (7.0:48.0)	0.240 (0.960)
Knee pain during activity, Post-OP <sup>1</sup> , median (range)	12 (0.0:90.0)	20 (0.0:100.0)	26 (0.0:97.0)	0.002 (0.006)
Quality of life after surgery <sup>1</sup> , median (range)	77.5 (13.0:98.0)	70 (0.0:100.0)	69 (0.0:100.0)	0.055 (0.219)
Level of symptoms after surgery <sup>1</sup> , median (range)	21 (0.0:94.0)	23 (0.0:100.0)	31 (0.0:95.0)	0.182 (0.728)
Difference in outcome parameters:				
Difference in Pain <sup>1</sup> , median (range)	8 (-11.0:84.0)	15 (-90.0:100.0)	21 (-48.0:97.0)	0.012 (0.069)
Difference in Quality of life Post-OP <sup>1</sup> , median (range)	-7 (-67.0:95.0)	-20 (-100.0:98.0)	-18 (-99.0:98.0)	0.003 (0.017)
Difference in level of symptoms <sup>1</sup> , median (range)	15 (-14.0:89.0)	17 (-56.0:100.0)	18 (-41.0:95.0)	0.532 (3.193)

<sup>1</sup>Visual analogue scale 0-100. BMI: Body mass index.

have lower pre-OP expectations. African Americans have been found to be less knowledgeable regarding OA, to have a lesser understanding of the risks and benefits of surgery compared to White Americans<sup>[30,31]</sup>, and to have a lower preference for surgical treatment<sup>[25]</sup>. This could explain our finding of more severe pre-OP symptoms in patients of minority ethnicity, as patient preference has been associated with referral from GP to orthopaedic evaluation in OA patients<sup>[25]</sup>. Many American-based studies report that minorities are more likely to undergo surgery at low volume hospitals and that this is a cause for poorer outcome. This does not apply in Denmark, as most patients are treated in the public system and all our data are based on patients treated in one high-volume public institution. Severity of pre-OP symptoms has been shown to influence outcome<sup>[4-6]</sup>. Although our post-OP response rate was too low to make any conclusions, we did find that the overall outcome for patients born outside

the country was poorer compared to patients born in the country, which is concurrent with the reportings of Krupic *et al*<sup>[12]</sup>. Similar findings have been reported in American patients, where minorities are reported to have a higher post-OP complication rate, mortality and longer hospital stay compared to white Americans<sup>[25,26]</sup>.

The duration of education is key to how individuals seek and handle information<sup>[32]</sup>, and therefore important with regard to how patients cope with medical treatment. We found that patients with > 12 years of education had more severe pre-OP symptoms than those with shorter educations. This result is not concurrent with findings in previous studies, as these have found more severe symptoms in patients with shorter education; an educational level less than high school in the United States has been associated with greater pre-OP pain and lower function in TKA patients by Lopez-Olivo *et al*<sup>[33]</sup>. Although we found significant *P*-values

for these parameters, the differences of OKS was only three, two and nine on VAS, thus both below MCID and not convincingly clinically-relevant. High education has previously been found to be a predictor for better post-OP outcomes by Greene *et al.*<sup>[13]</sup>, while others report no significance<sup>[34]</sup>. We found that patients with short educations reported a lower post-OP pain severity (MCID below cut-off level), and could find no other significant influence of education on other outcome parameters. Although statistically significant, Greene *et al.*<sup>[13]</sup> also found very small differences that were not clinically relevant. It is thus uncertain whether education can be used as an outcome predictor for TKA patients. Combined with our low response rate, no findings regarding education and post-OP outcome were convincing.

Our study has several limitations, as this is a purely descriptive and hypothesis-generating study. External validation is a major limitation for our study, as both ethnicity and education differ between countries. Education differs greatly across the world; we have, however, tried to accommodate this by dividing patients into three groups based on their number of education years rather than completed degrees. Ethnic minority groups within a country are of course different across the world. In this study, we try to address the issues that arise in healthcare for people born outside their residential country and not the health care behaviour of specific ethnic groups. We believe that our results can contribute to the knowledge base for how to approach racial disparities within a population.

Our results are based on regression analysis, adjusting for patient-related factors such as gender, smoking, alcohol consumption, co-morbidities, symptoms, self-reported QoL and expectations as shown in the Tables. Residual confounders include the missing evaluation of radiologic status/alignment. Surgical factors have been shown to influence patient satisfaction in other studies, and this is unaccounted for in our study; however, all patients were treated by the same high-volume surgeons in a well-defined fast-track setup with standardized treatment for pain, mobilisation and post-OP care, as described in the Methods section<sup>[1]</sup>. All treatments in Denmark are free of charge, and therefore socioeconomic factors do not affect the choice of implant in our population. Only 44.6% of patients responded to our post-OP questionnaire, and response rate was even lower for patients born outside the country (26.2% vs 46.2% for patients born in the country). We therefore make no conclusions regarding significance of either ethnicity or education on post-OP measurements. In this study, we have only evaluated results based on patient-reported outcome measures, and not other outcome measures such as the length of hospital stay, infection rate or other complication rates.

In conclusion, minority ethnicity and duration of education influence pre-OP disability and expectations in patients undergoing TKA. This should be taken into

account when patients are advised pre-operatively.

## ARTICLE HIGHLIGHTS

### Research background

The background, present status, and significance of the study should be described in detail. It is known that patient-related factors, socioeconomic factors and education influence patient outcomes in general, however this area is difficult to investigate and thus these factors are often confounding in scientific work. These factors are also known to be of significance in patients scheduled to undergo total knee arthroplasty (TKA), and this study provides information regarding the significance of education and ethnicity in these patients.

### Research motivation

During recent years, a trend towards optimized care, standardized patient evaluations and fast-track surgery has been influencing orthopaedic surgery. Although beneficial in many ways, this concept may not be appropriate for all patients. Levels of education and ethnicity is known to influence patients, and understanding the significance of these factors in TKA patients will assist healthcare providers in optimizing treatment plans for individual patients.

### Research objectives

The objectives of this study were to determine if level of education and ethnicity influence the preoperative status of patients undergoing primary TKA or patient expectations for surgery. The significance of ethnicity and level of education on outcome following TKA is still uncertain and should be an objective for future research.

### Research methods

We prospectively included 829 patients undergoing TKA. Patients filled in pre-operative questionnaires with information regarding place of birth, duration of education, expectations for outcome of surgery and baseline characteristics. Statistical analyses were performed to identify the significance of ethnicity and level of education.

### Research results

We find that patients undergoing TKA in a country different to where they were born report more severe preoperative symptoms and lower expectations for postoperative outcome. We also found that patients with a longer duration of education report more severe pre-operative symptoms. We found that patients of minority ethnicity and with an education > 12 years had more severe symptoms post-operatively. However, due to a low response rate, we cannot draw generalizable conclusions about these results. The significance of ethnicity and education on post-operative results remain to be sufficiently described.

### Research conclusions

Minority ethnicity and duration of education influence preoperative disability and expectations in patients undergoing TKA. Patients undergoing TKA in a country different to where they were born need individualised evaluation to accommodate potential differences from the general patient population. Patients of minority ethnicity report more severe pre-operative symptoms before undergoing TKA and lower expectations for post-operative outcome. Patients with educations longer than 12 years report more severe symptoms before undergoing TKA. Minority ethnicity and duration of education influence preoperative disability and expectations in patients undergoing TKA. Ethnicity and education influence patients' perception of disease. Socioeconomic factors should be considered when evaluating patients.

### Research perspectives

Our study provides knowledge regarding the significance of ethnicity and education on preoperative disability and expectations of outcome. This information is key for healthcare professionals when evaluating patients prior

to TKA, as it allows for the identification of individuals who may not be suitable for a standardized information regimen. It is important to investigate the significance of socioeconomic factors on outcome following TKA.

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